In the Final Office Action of August 4, 2008 in the subject application, claims 15-20, 23, 24 and 27-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of an article by Swain et al., taken in combination with U.S. Patent Application Publication No. 2002/0021444 to Macfarlane, U.S. Patent No. 6,950,554 to Shiratani and further in combination with U.S. Patent No. 6,911,963 to Baba. Claims 21 and 22 were rejected under 35 U.S.C. 103(a) as being unpatentable over the above combination and further in view of U.S. Patent No. 5,268,753 to Yamaguchi. Claims 25 and 26 were rejected under 35 U.S.C. 103(a) over the primary combination and further in view of U.S. Patent No. 6,486,981 to Shimura. Claims 33 and 34 were rejected under 35 U.S.C. 103(a) over the primary combination and further in view of U.S. Patent No. 6,751,348 to Buzoloiu. Claims 35 and 36 were rejected under 35 U.S.C. 103(a) as being unpatentable over the primary combination of references, as discussed above, and further in view of EPO 473432 to Harrington.

Since claims 15 and 16 are the two independent claims that are pending in the subject application, and since they are directed to the use of similar methodologies to attain the same results, the bulk of the discussion in this Second Amendment will be directed to a discussion of the substantial differences between these claims and the prior art cited and relied on in their rejections. That discussion will be directed initially to the Swain et al. publication. It is respectfully asserted that the discussion of that document, as set forth in the Final Office Action, is factually inaccurate, asserts that claimed features are present when they, in fact, are not, and makes conclusions as to the relevancy of the document which are not supportable by that document.

Initially, it is to be kept in mind that the object of the subject invention, as set forth in currently amended claims 15 and 16, is to analyse color deviations in a printed image, with the goal of determining the acceptability of those printed images. The goal of the Swain publication is to develop visual skills for robots so that they can determine the location of a known object. It

REMARKS

The final Office Action of August 4, 2008 in the subject U.S. patent application has been carefully reviewed by applicants, their principal representatives in Germany, and the undersigned. A Request For Continued Examination (RCE) is being filed concurrently with this Second Amendment. It is believed that the claims, as previously presented, and even more clearly as currently amended, are patentable over the prior art cited and relied on by the Examiner, when that prior art is properly considered. Reexamination and reconsideration of the application, and allowance of the claims is respectfully requested.

As set forth in the Substitute Specification, as depicted schematically in the drawings, and as recited in the currently amended claims, the subject invention is directed to methods for analyzing color deviations of a printed image. As discussed at paragraph 028 of the Substitute Specification, the acceptability of printed products is determined by analysis of outputs of color compensation channels. These color compensation channels are adaptations of the image content of pixel by pixel images to process the image sensor signals of these pixels to compensate for differences between what the image sensor sees and what the human eye sees. As noted at paragraph 003 of the Substitute Specification, the trichromatic model, which is the RGB model, does not provide a color description that meets the perception of the human eye. In order to accommodate for this difference between what an image sensor sees, and what the human eye sees, the date provided by the image sensor is modified, using calculation specifications, to provide compensation color channels that correspond to receptive fields of the human eye. Once the image data from the image sensor has been formed using the calculation specifications, which result in resultant compensation color channels that correspond to color receptive fields of a human eye, the output signals of the first and second compensation channels are classified. These classified signals are used to determine an acceptability of the printed image.

is quite clear that the goals of the subject method and of the color indexing proposed by the Swain article are neither similar or even related.

In the Swain procedure, as recited in the second paragraph of the abstract, it is demonstrated "...that color histograms of multicolored objects provide a robust, efficient cue for indexing into a large database of models." The first question is what is a color histogram? As set forth in the Swain article, and as depicted at the right of page 29 thereof, "...the color histogram is obtained by discretizing the image colors and counting the number of times each discrete color occurs in the image array." This is set forth at page 13 in the first sentence under the heading "2. Color Histograms". As set forth in the accompanying definition, which was taken from The Living Webster Dictionary, a histogram is...a frequency distribution graph consisting of rectangles which correspond in width to class intervals and correspond in height to frequency values. See Exhibit A. The depiction of the color histograms at the right of page 29 of the Swain article is the histogram that results from the separation of the colors that make up a Crunchberries cereal box and the counting of the number of times that each discrete color occurs in the image array on the cereal box. It is the basic premise of the Swain article that a unique color histogram can be provided for each of the large database of models. That large database thereby allowing a robot to view an object, to create a color histogram of that object and to compare that color histogram with the number of color histograms in its database. The desired result will be that the robot can select the Crunchberries cereal box from other objects, all of whom have their own color histograms.

How does Swain propose to construct his histograms? He needs to count how much of each color appears in an image. Since a histogram has only a finite number of "bins" into which to place all of the colors that are detected, as discussed in the second sentence of the paragraph starting at the right on page 13, there must be some clarification of colors, as a function of the number of "bins" or spaces in the histogram, which is essentially a graph or a chart, so that each color is able to be placed in one "bin".

At the top of the left paragraph of page 16, the Swain article discusses the three color axes which were used for the histogram as three opponent color axes. As set forth in the Wikepedia article on Opponent Process, Exhibit B, there are three opponent channels

1) red versus green
2) blue versus yellow
3) black versus white

Opponent channels are so named because the two colors oppose each other. For example, there is no blackish white or whitish black. The two colors in each opponent channel oppose each other. A color axis is a length or number of shades that the difference between black and white, for example, can be divided into. In the Swain article, the black/white color axis was divided into 8 sections or shades. The red/green and blue/yellow color axes were each divided into 16 sections or shades. The resultant histogram had 2048 "bins" into which all of the shades of color of an object, such as the Crunchberries cereal box could be divided. The resultant histogram, again as viewed at the right of page 29 is a unique histogram that separates the colors in a Crunchberries cereal box. Again, the object is for a robot to use a color camera so that it can identify a particular object by its unique color histogram or color fingerprint.

With this analysis of the Swain publication in mind, it is now quite apparent that the Examiner's comments with respect to that article, and reliance on that article, as a basis for the rejections of the claims in the subject application is not correct. Swain was characterized as disclosing a color image deviation analysis method. A deviation would mean that one color image deviates from another. In fact, Swain proposes a process by which a color image of an unknown object is compared with color images of known objects, which are stored in a large database of such known objects, in an effort to identify the unknown object. Swain is not attempting to determine color deviations. Instead, he is attempting to find a color match. Swain has provided his database with color histograms that reprint known objects. He is asking his

robot to look at the unknown object and to match it with one of the known objects in the database, using the color histograms. Like fingerprint analysis, Swain is not asking the robot to identify differences. He is not asking the robot to detect differences between the color histograms of the unknown object and those of all of the known objects. He is asking the robot to identify the unknown object by locating the color histogram in the computer's database that matches the color histogram of the unknown object. If there are no matches, the unknown object cannot be identified. The robot will not provide an analysis of the differences and a comparison of the differences. It will simply be unable to identify the object.

In the Swain publication, the image sensor does use the three opponent color axes to form the histogram. However, in the Swain publication, the three color axes were used to divide all of the colors of the Crunchberries cereal box into individual shades, each one of which would fit into one of the 2048 bins of the color histograms being created. With the Crunchberries box, only 512 bins received an appreciable number of color shade images.

The recitation in Swain of three opponent color axes is not the same as the recitation in the claims of the subject invention of providing a separate image sensor signal for each of the first, second and third separated color channels. In the subject invention, each pixel is analyzed by the image sensor, and separate image sensor signals are generated for each pixel. The signal for each pixel is separated into its three components and a separate image sensor segment is provided for each of the three separated color channels for each pixel. That is not the same, or similar to the use of opponent color axes to classify shades containing a black/white color axis into one of 8 sections or shades, as recited in Swain. Swain does not separate sensor signals into red, green and blue as first, second and third color channels. Swain determines shades of colors containing three opponent color axes.

Starting midway at page 3 of the Final Office Action, the Examiner takes language from the claims of the subject application and recites, without any support, that the Swain reference somehow provides those teachings. The purpose of the subject application's method is to

analyze color deviations of a printed image to determine if the color image is acceptable. A first step is to link a first color channel image sensor signal with a second color channel image sensor signal by using a first calculation specification. There is no similar process disclosed in the Swain article. Instead, Swain takes color signals received along three opposition color axes and separates them into shades to populate a color histogram. There is no discussion in the Swain reference of linking color channels to each other using calculation specifications. There is also no discussion in Swain of selecting the first calculation specification to correspond to a red/green reception field of a human eye.

In the Office Action, it is recited that Swain's methodology takes human vision into consideration by "...subtracting the received signal color of green from the first color signal of red to generate the first rg output signal...". That interpretation of Swain Is not correct. Again referring to the top of the left column of page 16 of the Swain article, the three color axes for the histogram are the three opponent color axes. One of them is the red versus green color axis, as discussed in Exhibit B. The expression at the top of the left column of the Swain article does not indicate that green is somehow subtracted from red. It indicates that the color red and green are opponent colors and that their axis, or the shade line between the two, was divided into 16 shades, for purposes of diversification of colors.

Swain does not teach, or support the generation of a first output signal of a first resultant color compensation color channel using the first calculation specification linked first and second color channel image sensor signals. The Examiner also relies on the identification, in the Swain article of the blue/yellow opponent color axes, as being mathematical functions of each other. The representations at the top left of page 16 of the Swain article are not mathematical expressions. They are representations of the opponent color axes along which along which shades of the opponent colors are classified so that they can be divided into shades. There is no teaching or suggestion in the Swain article of the features of claims 15 and 16 attributed to it, as set forth in the final Office Action, at pages 3 and 4 thereof.

The Macfarlane reference is not directed to a field of endeavor that is similar either to that of the Swain publication, or to that of the subject invention. In the Macfarlane publication, there is disclosed a method and system for measuring the color of skin, teeth, hair and materials substances. This has nothing to do with robot vision for the purpose of attempting to identify an object from among a group of objects stored in a computer's database using a color histogram of the unknown object, and a comparison of that unknown histogram with the known histograms in the robot's database. Macfarlane also has nothing to do with a method of analyzing color deviations of a printed image for the purpose of determining an acceptability of that printed image by using classification of first and second output signals.

In Macfarlane, the purpose is to provide a color measurement system and color index for skin, teeth, hair and the like which is calculated from a reflectance spectrum of any skin or teeth or hair. The weighting factors noted by the Examiner are discussed at paragraph 0048 as being factors that correspond to red, yellow, green and blue contributions to color appearance. The weighting factors depicted in the referenced Table 1 are used to calculate a sample's reflectance spectrum's contribution to the appearance of redness, yellowness, greenness and blueness. Macfarlane uses the reflectance of a specimen to calculate his color index. This reflectance is independent of systems of illumination and relies purely on the reflectance of an object. The first step of the Macfarlane process is to weight the visible light spectra with a series of weighting factors. These calculate the contribution to the reflectance spectrum of skin or teeth or hair by the four opponent colors red-green and yellow-blue. These colors are placed in opponency to each other.

The discussion at the bottom of page 5 of the Final Office Action, and continuing at the top of page 6 again attempts to incorporate the language of the claims of the subject invention into the discussion of the prior art references. Swain does not teach or suggest "...a color image deviation analysis method". As discussed above, Swain teaches a method of robot computer vision using color histograms of known objects. There is no color image deviation

analysis in Swain. The Macfarlane publication uses a sample's reflectance spectrum to arrive at a color index for that particular sample of hair or teeth or skin or the like. Macfarlane selects reflectance spectrum analysis because it is independent of levels of illumination. That has nothing to do either with the subject invention or with the Swain publication. In fact, Swain recites, at the top of the right column of page 12 that color can be used as an identifying invariant of object surfaces, even under varying light conditions. Swain is measuring color shades and hues. He is not measuring reflectance spectrums. The weighting factors discussed in Macfarlane go to how the various colors of opponency; i.e. red-green and blue-yellow affect the reflectance spectrum of an object.

In the subject invention, as recited in claims 15 and 16, the compensation color channels are formed corresponding to a red/green reception field of a human eye and to a blue/yellow reception field of a human eye. These calculation specifications are selected for forming weighted differences between the color channel sensor signals. All of this is done so that the analysis of the color deviation of the printed images, performed using the method recited in claims 15 and 16 will result in a determination of the acceptability of the printed image that would be similar to what would be expected if one were to analyze color deviations by eye, not by the use of printed image sensors. That is why the first and second resultant compensation color channels of the present invention correspond to the red/green reception field, and to the blue/yellow reception field of color perception of a human eye.

In the third reference to Shiratini, U.S. Patent No. 6,950,554 there is disclosed a learning type of image classification apparatus and method. The specification is, at best, difficult to read and to understand. It appears to be directed to a method and to an apparatus to classify objects by their appearance or location. It is believed that the system of Shiratini indicates a learning phase, in which sections of an image are to be classified. Once that has been done, the images are "clipped" and are classified. The images can be selected manually during a learning mode

and can be clipped and identified by the user. As the learning phase progresses, the program no longer requires direct human intervention.

The Shiratini reference has nothing to do with the fields of endeavor of either the subject invention or of the prior two references. The subject invention is directed to a method for analyzing color deviations in printed materials. The Swain publication is directed to the teaching of a robot to identify a specific object from a plurality of known objects, based on a color histogram of the specific object. The Macfarlane reference is a system for identifying colors of skin, teeth, hair and the like based on reflectance. The Shiratini reference is directed to a system for classification of objects. The combination of these references, even if such a combination were possible, would not result in a method at all similar to that set forth in claim 15.

The Baba reference, U.S. Patent No. 6,911,963 is directed to a field-sequential color displaying method. This is a procedure for providing a color display that is not dependent on additive color mixing systems. Instead, each separate color is displayed for a period of time. The speed of display of each color is so fast that the observer cannot recognize the divided periods.

It again appears that the Examiner has relied on computer database searching to find reference phrases which match claim phrases, and to then assert that the reference in which the selected phrase appears is somehow relevant. As the risk of being repetitive, the Swain publication is not directed to a field of endeavor that is similar to that of the subject invention. The three secondary references are also not directed to similar fields of endeavor. In the Baba reference, the object is to use a field-sequential color display unit to provide color displays of reduced color breakup. The language of claim 16 of the subject application is directed to the method of analyzing color deviations of printed images. Baba has nothing to do with printing. It has nothing to do with an analysis of color deviations of printed images. The section of Baba relied upon by the Examiner is not relevant to the portion of claim 16 that is different from claim

15. In claim 16 it is recited that the second calculation specification is selected so that it is providing a linkage of at least one of the first and the second color channel image sensor signals with the third color channel image sensor signal. That has nothing to do with the Baba reference which is directed to a display of a color image by division of the color image into constituent single color images for use with a color display in a color monitor. The selection of a Y or yellow signal, which is a combination of red and green signals, is done to reduce the color breakup of an optical image that will be displayed on a color display. What relevance that has to the subject invention, as recited in claims 15 and 16, is not readily apparent to the undersigned.

All of the rest of the claims now pending in the subject application are dependent on either one or the other of believed allowable currently amended claims 15 and 16. These claims are also believed to be allowable.

The undersigned has reviewed the Examiner's Response to Arguments and to the extent that these have not been addressed in the prior remarks, the following comments are believed to be appropriate. The Swain reference is not directed to the field of endeavor of the analysis of color deviation of a printed image for the purpose of determining the acceptability of that color image. It is directed to robot computer vision using color histograms. The selective quoting, out of context, of parts of a reference do not somehow change the basic thrust of that reference. Swain does not suggest primary color manipulation to generate three opponent color axes. The concept of opponent color axes is not unique to Swain or to any other reference. It is a color theory that acknowledges that certain colors are opponent colors. As recited in the Macfarlane reference, opponent colors are ones in which no color can exhibit qualities of both of the opponent colors at the same time. The "color pairs" asserted as being set forth in Swain are not unique to Swain and are not relevant to the subject matter as recited in amended claims 15 and 16.

With respect to the Macfarlane reference, the weighting factors are directed to the influence that each color has on the reflectance spectrum of a particular skin or tooth or hair sample. The weighting factors do not affect the variable appearance of the image. They affect how a color index, that is used in a color measurement system, will be determined.

SUMMARY

Claims 15 and 16 have again been amended in an effort to more clearly patentably define the subject matter over the prior art cited and relied on. A Request For Continued Examination has been filed concurrently with the filing of this Second Amendment.

Allowance of the claims, and passage of the application to issue is respectfully requested.

Respectfully submitted,

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EXHIBIT A

The

LIVING WEBSTER

Encyclopedic

DICTIONARY

of the English Language

With a Historical Sketch of the English Language by
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his, hiz, *pronominal a.* [In O.E. the genit. sing. of *hē*, he, and of *hit*, it.] The possessive case of the personal pronoun *he*, used as an attributive; as, *his* picture.—*pron.* Of or belonging to him: the possessive case of *he* used, instead of *his* and a noun, as subject, object, or predicate noun, as: *His* is the best, I read a book of *his*.

His·pan·ic, hi·span′ik, *a.* Spanish; pertaining to Latin America, Spain, and Portugal, their people, language, or culture. —**His·pan·i·cism,** *n.* A Spanish phrase or idiom.—**His·pan·i·cize,** *v.t.*—*Hispanicized, Hispanicizing.* To make Spanish, as in taste or style; to lead into Spanish influence.

his·pa·nism, his′pa·niz″um, *n.* (*Often cap.*) a Latin American movement directed toward promoting the Spanish language and culture.

his·pid, his′pid, *a.* [L. *hispidus*, rough, hairy.] *Biol.* Shaggy; bristly; covered with stiff bristles or spines.—**his·pid·i·ty,** his·pid′i·tē, *n.*—**his·pid·u·lous,** hi·spij′*a*·lus, *a. Biol.* having short bristly hairs.

hiss, his, *v.i.* [O.E. *hysian*, O.D. *hissen*, imit. of sound.] To make a sound like that of the letter *s*, as that of serpents or of water thrown on hot metal; to emit a similar sound in contempt or disapprobation.—*v.t.* To utter with a hissing sound; to condemn or express disapproval by hissing; to silence by uttering a hissing sound, often with *down* or *off*. —*n.* The sound made by propelling the breath between the tongue and upper teeth, as in pronouncing the letter *s*, especially as expressive of disapprobation; any similar sound.—**hiss·er,** *n.*

hist, hist, *interj.* A sibilant exclamation used to attract attention or command silence.

His·ta·drut, his·tä·dröt′, *n.* [Heb.] The major trade union of Israel, established in 1920.

his·tam·i·nase, hi·stam′*i*·nās″, *n. Biochem.* an enzyme which deactivates a histamine, and therefore is used to treat certain allergies.

his·ta·mine, his′t*a*·mēn″, his′t*a*·min, *n.* [< (*hist*)*idine* and *amine*.] *Biochem.* an amine, found in the tissue of all plants and animals and released during allergic reactions, that dilates the capillaries, stimulates gastric secretion, and causes uterine contractions.—**his·ta·min·ic,** his″t*a*·min′ik, *a.*

his·to·gen·e·sis, his″t*o*·jen′i·sis, *n. Biol.* the origin, development, and differentiation of tissues. Also **his·tog·e·ny,** his·toj′*e*·nē. —**his·to·ge·net·ic,** his″t*o*·j*e*·net′ik, *a.*—**his·to·ge·net·i·cal·ly,** *adv.*

his·to·gram, his′t*o*·gram″, *n. Statistics,* a frequency distribution graph consisting of rectangles which correspond in width to class intervals and correspond in height to frequency values.

his·tol·o·gy, hi·stol′*o*·jē, *n. Biol.* the study of plant and animal tissues, esp. of their microscopic structures; the structure, esp. the microscopic structure, of a given tissue of an organism.—**his·to·log·ic, his·to·log·i·cal,** his″t*o*·loj′i·k*a*l, *a.*—**his·to·log·i·cal·ly,** *adv.*—**his·tol·o·gist,** *n.*

his·tol·y·sis, hi·stol′i·sis, *n. Biol.* the dissolution and breaking down of organic tissues.—**his·to·lyt·ic,** his″t*o*·lit′ik, *a.*

his·tone, his′tōn, *n.* [Gr. *histos*, web, tissue.] *Biochem.* any of a class of protein substances, as globin, having marked basic properties and, on hydrolysis, yielding amino acids.

his·to·ri·an, hi·stōr′ē·*a*n, hi·st*a*r′ē·*a*n, *n.* A writer of history; an authority in history; one who compiles records or documents for a particular purpose; a chronicler.

his·tor·ic, hi·st*a*r′ik, hi·stor′ik, *a.* [L. *historicus*, < Gr. *historikos*, < *historia*, E. *history*.] Important or celebrated in history; memorable; historical.

his·tor·i·cal, hi·st*a*r′i·k*a*l, hi·stor′i·k*a*l, *a.* Of or pertaining to history; of the nature of or constituting history; following, or in accordance with history, esp. as opposed to legend or fiction; dealing with history; as, a *historical* work; using history as a basis; as, a *historical* novel; noted or celebrated in history; historic.—**his·tor·i·cal·ly,** *adv.* —**his·tor·i·cal·ness,** *n.*

his·tor·i·cal ma·te·ri·al·ism, *n.* The division of Marxist theory that deals with social history and causation. Compare *dialectical materialism.*

his·tor·i·cal pres·ent, *n. Gram.* the use of the present tense in an account of past actions.

his·tor·i·cal school, *n.* Any of several schools of thought which emphasize the importance of historical events and analysis in the study of law, economics, and related subjects.

his·to·ric·i·ty, his″t*o*·ris′i·tē, *n.* Historical quality or authenticity based on fact.

his·to·ri·og·ra·pher, hi·stōr″ē·og′r*a*·fėr, hi·st*a*r″ē·og′r*a*·fėr, *n.* [L.L. *historiographus*, < Gr. *historiographos*, < *historia*, history, and *graphein*, write.] A historian, esp. an official historian, as of a public institution.—**his·to·ri·og·ra·phy,** *n.*—**his·to·ri·o·graph·ic, his·to·ri·o·graph·i·cal,** *a.*—**his·to·ri·o·graph·i·cal·ly,** *adv.*

his·to·ry, his′t*o*·rē, his′trē, *n.* pl. **his·to·ries.** [L. *historia*, a history, < Gr. *historia*, a learning by inquiry, < G. *histor*, knowing, learned; same root as E. *wis*, *wit*, to know. *Story* is a short form of this.] That branch of knowledge which deals with events that have already taken place; the study or investigation of the past; a narrative or account, usu. chronological, of past events in the life of a nation, community, institution, or the like; the sum total of past happenings; anything that happened in the past; any past filled with unusual or memorable happenings; a drama dealing with past events; a story or tale.

his·tri·on·ic, his″trē·on′ik, *a.* [L. *histrionicus*, < *histrio*, an actor; same root as Skt. *has*, to laugh at.] Pertaining to actors or to acting; belonging to stage playing; theatrical; affected; melodramatic. Also **his·tri·on·i·cal.**—**his·tri·on·i·cal·ly,** *adv.*

his·tri·on·ics, his″trē·on′iks, *n. pl., sing. or pl. in constr.* Dramatics or theatricals; affected behavior; an insincere display of emotion.

hit, hit, *v.t.*—*hit, hitting.* [O.E. *hyttan* = Icel. *hitta* = Sw. *hitta* = Dan. *hitte*, hit on, find.] To deal a blow to; to come against with an impact or collision; to reach with a missile, a weapon, a blow, or the like; as, to *hit* the mark; *baseball*, to strike, as a ball, with a bat; to drive or propel by a stroke; to reach or touch directly and effectively; as, to be *hit* by satire or innuendo; affect severely; as, to be badly *hit* in a financial panic; to succeed in representing, imitating, or producing exactly; as, to *hit* a likeness in a portrait; to conform to or suit exactly; as, to *hit* one's fancy. *Slang*, to attain or arrive at; as, to *hit* shore; to demand, as money, from; to be seen in; as, to *hit* the papers.—*v.i.* To deal a blow or blows; to strike with a missile or weapon; to come into collision, often with *against*, *on*, or *upon*; to come to light, with *upon* or *on*; as, to *hit on* a new way of doing something.—**hit it off,** to agree; get along with.—**hit or miss,** haphazard.

hit, hit, *n.* An impact, collision, or blow; any shot that reaches its objective; an effective remark or expression; a stroke of satire or censure, as: The letter contained severe *hits* at the administration. One who or that which is a noted success, as: His new album is a big *hit*. A stroke of good fortune; *backgammon*, a victory won by a player after his opponent has thrown off one or more men from the board; *baseball*, a base hit.

hit-and-run, hit′*a*n·run′, *a.* Designating or relating to the driver of an automobile who fails to stop or identify himself upon being involved in an accident; marked by quick action; as, a *hit-and-run* attack. *Baseball*, pertaining to a play in which the runner proceeds to the next base as the batter attempts to hit the ball.

hitch, hich, *v.t.* [Akin to Prov. E. *hick*, to hop or spring; G. dial. *hiksen*, to limp; Sc. *hotch*, to move by jerks, to hobble; Prov. E. *huck*, to shrug.] To fasten temporarily by a knot or hook; to harness or yoke, as a horse, to a vehicle, sometimes followed by *up*; to jerk or raise up; *slang*, to hitchhike; *colloq.* to marry.—*v.i.* To move jerkily or haltingly; to become entangled, caught, or hooked; to be linked or yoked; to hitchhike rides.—*n.* A sudden jerk, tug, or catch; a limp; an unexpected hindrance in plans; a device for attaching something temporarily; *naut.* a knot or noose in a rope for fastening it to an object. *Slang*, a period spent in military service; a ride or lift.—**hitch·er,** *n.*

hitch·hike, hich′hīk″, *v.i.*—*hitchhiked, hitchhiking.* To travel by signaling vehicles and obtaining free rides, often interspersed with stretches of walking.—*v.t.*—**hitch·hik·er,** *n.*

hith·er, hiᴛʜ′ėr, *adv.* [O.E. *hider*, *hither*, Goth. *hidre*, Icel. *hethra*, hither.] To this place; here.—*a.* On this side or in this direction; nearer.—**hith·er and thith·er,** to this place and that; here and there.

hith·er·most, hiᴛʜ′ėr·mōst″, *a.* Closest to this place.

hith·er·to, hiᴛʜ′ėr·tö″, *adv.* To this time; until now. *Archaic*, to this place.

hith·er·ward, hiᴛʜ′ėr·wėrd, *adv.* Toward this place. Also **hith·er·wards.**

Hit·ler·ism, hit′ler·iz″*u*m, *n.* The principles and practices of the Nazi party under Adolf Hitler.—**Hit·ler·ite,** hit′le·rīt″, *n.* One who adheres to Hitler's doctrines.—*a.* Referring to Hitler or Hitlerism.

Hit·tite, hit′īt, *n.* One of a powerful, civilized ancient people who flourished in Asia Minor and adjoining regions for about seven centuries before 1200 B.C. until subjugated by the Assyrians; a language of the Anatolian branch, used by the Hittites. —*a.* Referring to the Hittite people or their language.

hive, hīv, *n.* [O.E. *hȳf*, perhaps akin to Icel. *hūfr*, ship's hull, and L. *cupa*, tub, cask.] An artificial shelter for the habitation of a swarm of honeybees; a beehive; something resembling or suggesting this, as in structure, shape, or use; a place swarming with busy occupants; as, a *hive* of industry; the bees inhabiting a hive; a swarming or teeming multitude.—*v.t.*—*hived, hiving.* To gather into or cause to enter a hive, as bees; to shelter, as in a hive; to store up in a hive; to lay up for future use or enjoyment.—*v.i.* To enter a hive, as bees; to live together in the manner of bees; to dwell as in a hive.

hives, hīvz, *n. pl., sing. or pl. in constr.* [Perhaps akin to *heave*.] *Pathol.* a skin condition in which there is an eruption of itching wheals over the body; urticaria.

ho, hō, *interj.* An exclamation expressing surprise, exultation, or, when repeated, derisive laughter; a cry to attract attention.

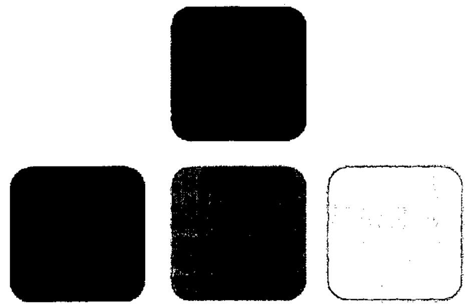
hoar, hōr, *n.* [O.E. *hār*, hoary, grayhaired; Icel. *hārr*, hoar, *hæra*, gray hair, hoariness; cf. Sc. *haar*, a whitish mist.] Hoarfrost; an appearance of age or venerability.—*a. Archaic*, hoary.—**hoar·i·ness,** *n.*—**hoar·y,** *a.*—*hoarier, hoariest.* Gray or white as with age; of or pertaining to age or venerability; of a whitish or light gray color.

hoard, hōrd, *n.* [O.E. *hord* = O.E. and G. *hort*, Icel. *hood*, Goth. *huzd*, hoard,

EXHIBIT B

Opponent process

From Wikipedia, the free encyclopedia



Opponent colors based on experiment. Deuteranopes will see little difference between the top and bottom colors in the central column.

The color **opponent process** is a color theory that states that the human visual system interprets information about color by processing signals from cones and rods in an antagonistic manner. The three types of cones have some overlap in the wavelengths of light to which they respond, so it is more efficient for the visual system to record *differences* between the responses of cones, rather than each type of cone's individual response. The opponent color theory suggests that there are three opponent channels: red versus green, blue versus yellow, and black versus white (the latter type is achromatic and detects light-dark variation, or luminance).[1] Responses to one color of an opponent channel are antagonistic to those to the other color.

While the trichromatic theory defines the way the retina of the eye allows the visual system to detect color with three types of cones, the opponent process theory accounts for mechanisms that receive and process information from cones. Though the trichromatic and opponent processes theories were initially thought to be at odds, it later came to be understood that the mechanisms responsible for the opponent process receive signals from the three types of cones and process them at a more complex level[2].

Besides the cones, which detect light entering the eye, the biological basis of the opponent theory involves two other types of cells: bipolar cells, and ganglion cells. Information from the cones is passed to the bipolar cells in the retina, which may be the cells in the opponent process that transform the information from cones. The information is then passed to ganglion cells, of which there are two major classes: magnocellular, or large-cell layers, and parvocellular, or small-cell layers. Parvocellular cells, or P cells, handle the majority of information about color, and fall into two groups: one that processes information about differences between firing of L and M cones, and one that processes differences between S cones and a combined signal from both L and M cones. The first subtype of cells are responsible for processing red-green differences,and the second process blue-yellow differences. P cells also transmit information about intensity of light (how much of it there is) due to their receptive fields.

Contents

History

Johann Wolfgang von Goethe first studied the physiological effect of opposed colors in his Theory of Colours in 1810.[3] Goethe arranged his color wheel symmetrically, "for the colours diametrically opposed to each other in this diagram are those which reciprocally evoke each other in the eye. Thus, yellow demands violet; orange, blue; red, green; and vice versa: thus... all intermediate gradations reciprocally evoke each other."[4]

Ewald Hering proposed opponent color theory in 1872.[5] He thought that the colors red, yellow, green, and blue are special in that any other color can be described as a mix of them, and that they exist in opposite pairs. That is, either red or green is perceived and never greenish-red; although yellow is a mixture of red and green in the RGB color theory, the eye does not perceive it as such.

In 1957, Hurvich and Jameson provided quantitative data for Hering's color opponency theory.[6]

Griggs expanded the concept to reflect a wide range of opponent processes for biological systems in this book Biological Relativity (c) 1967.

In 1970, Solomon expanded Hurvich's general neurological opponent process model to explain emotion, drug addiction, and work motivation.

The opponent color theory can be applied to computer vision and implemented as the "Gaussian color model."[7]

Subjective color and new colors

Reddish green and yellowish blue

Under normal circumstances, there is no hue one could describe as a mixture of opponent hues; that is, as a hue looking "redgreen" or "yellowblue". However, in 1983 Crane and Piantanida[8] carried out an experiment proving that, under special viewing conditions involving the use of an eye tracker, it is apparently possible to override the opponency mechanisms and, for a moment, get some people to perceive novel colors:

> "[s]*ome observers indicated that although they were aware that what they were viewing was a color (that is, the field was not achromatic), they were unable to name or describe the color. One of these observers was an artist with a large color vocabulary. Other observers of the novel hues described the first stimulus as a reddish-green.*"[9]

Other uses

Opponent processes have been used to explain color vision, pain, touch, emotions, smell, hearing, taste, and balance. It is basically an idea that for every stimulus there is an opposite neurological organization or structure to neutralize the response generated by the stimulus.

See also

- Natural Color System

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